

Waipapa Taumata Rau, Student Centre and Library

Geotechnical Groundwater and settlement Effects Report

Prepared for: The University of Auckland

Prepared by: Tonkin & Taylor Ltd

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1 Introduction

The University of Auckland Property Services (UoA) has engaged Tonkin & Taylor Ltd (T+T) to provide geotechnical consultancy services for the proposed basement retention design of the new UoA Waipapa Taumata Rau, Student Centre and Library on the corner of Princes Street and Alfred Street, Auckland Central (the site).

This report presents the groundwater analyses and an assessment of the combined geotechnical effects of the groundwater drawdown and basement excavation on the neighbouring land, buildings and public infrastructure.

The report should be read in conjunction with the T+T Geotechnical Interpretative Report (GIR)[1], which details the site-specific investigations, laboratory testing and groundwater monitoring undertaken for the development, and the interpretation of the site geological and hydrogeological conditions.

1.1 Scope of work

This report presents a summary of the design assessments and advice for the following:

1 Assessment of groundwater, comprising estimates for inflow volumes and groundwater drawdown to inform concept schemes for retention and long-term basement drainage

2 Assessment of the likely ground deformation related to groundwater drawdown and retaining wall deflections, associated with the proposed basement excavations at the site, which may affect neighbouring land, buildings and public infrastructure.

2 Background

2.1 Project description

The proposed development involves the demolition of the existing Student Union Building Complex (B311 and B312) and construction of a new Student Centre and Library within the northern portion of the wider property at 30–38 Princes Street, Auckland Central.

The proposed building comprises eight levels including two basement levels and six above ground levels with rooftop plant. Architectural layout plans[2] and preliminary retention sections[3] for the basement development have been provided by Warren and Mahoney ('WAM') Architects and Beca.

2.2 Proposed excavation

The proposed two-level basement comprises of an upper partial basement level (Level LG) and a lower basement level (Level B), with the proposed finished floor levels of 40.7 mRL and 36.1 mRL. respectively. During construction, an additional 1 m of bulk excavation below the proposed Level B finished floor level (35.1 mRL) has been assumed for the groundwater and retaining system design assessments.

Perimeter retaining walls will be required to support the proposed excavations. The western and south-western basement walls are located adjacent to Princes Street, where the existing ground elevation reaches approximately 45.6 mRL. The northern basement wall is located adjacent to Alfred

[1] T+T. October 2026. UoA Waipapa Taumata Rau, Student Centre and Library – Geotechnical Interpretive Report. Ref: 1103046-RPT-GEO-104.v1.
[2] Warren and Mahoney. 28 October 2026. Waipapa Taumata Rau, The University of Auckland Student Centre and Library. 100% FTAA Substantive Application, Appendix A: Architectural Drawings.
[3] Beca. September 2026. Student Centre and Library. Level B1 Foundation Plan. Ref: 5013381. Rev. B.

Street, where the ground generally slopes down towards the east, with elevations ranging from approximately 45.5 mRL to 42.6 mRL. The eastern basement wall is adjacent to the neighbouring Auckland University Student Association Building (B322) and the Kate Edger Information Commons Building (B315), the existing ground elevation is approximately 42.6 mRL.

The existing Hiwa Recreation Centre pool hall, a drained basement adjacent to part of the southern boundary of the site, extends below the level of the proposed Student Centre basement. It is envisaged that excavation in this area will be undertaken to the rear of the pool hall basement wall.

The permanent basement structure will be drained. As excavation and basement founding levels will extend below the measured groundwater levels, groundwater drawdown and diversion will occur during construction and in the permanent, long-term condition.

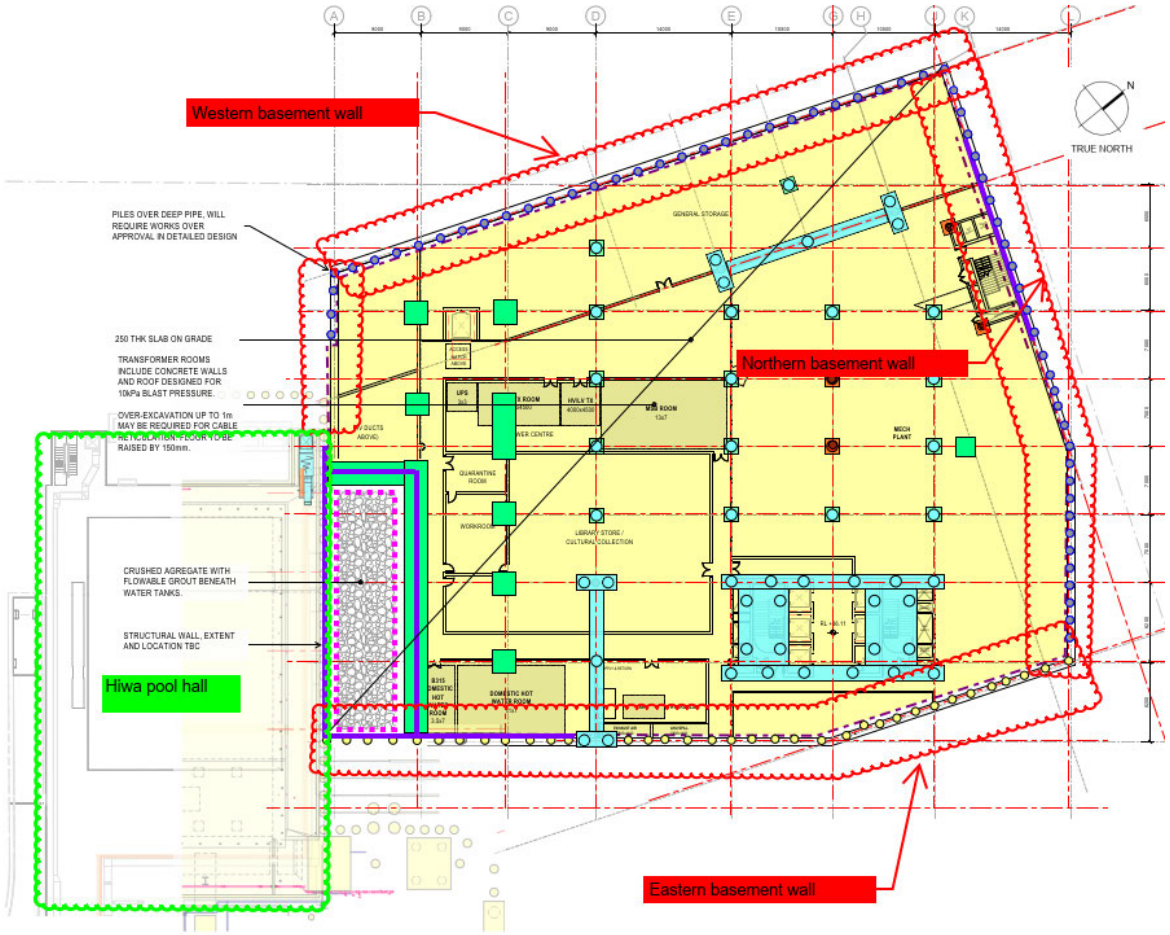

Figure 2.1: Lower basement (Level B) plan view and retaining zones.

2.3 Design critical sections

Three representative design sections have been selected for the groundwater drawdown and retention-induced settlement assessments. These sections represent the critical conditions along the western, northern and eastern sides of the proposed development, accounting for the local topography, retained heights, geotechnical and groundwater models, and proximity of neighbouring structures.

The locations of the selected sections are shown in Figure 2.2, and the corresponding geotechnical models are summarised in Section 2.5.

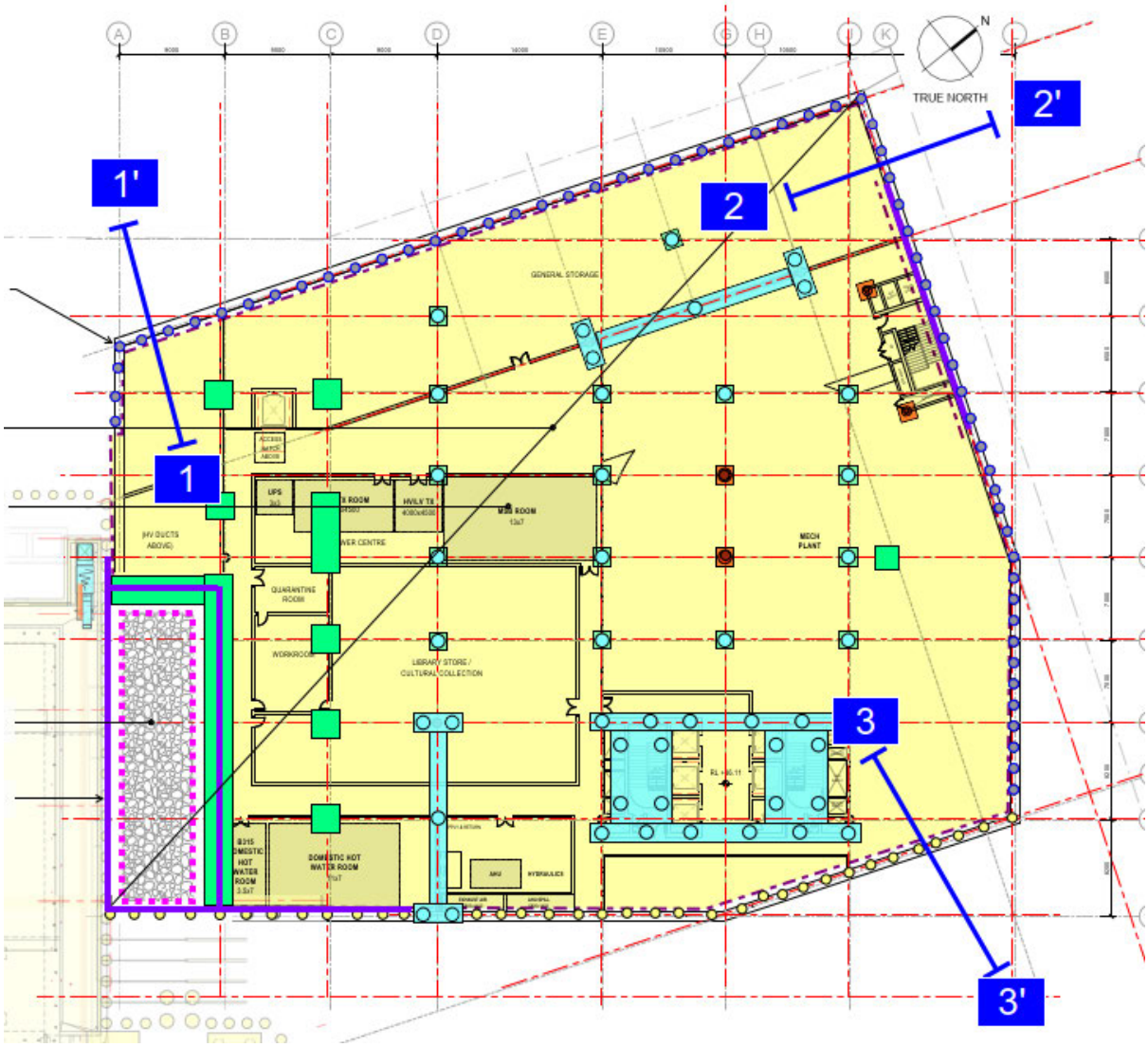

Figure 2.2: Locations of critical sections selected for the assessment.

2.4 Site setting

The proposed development footprint is southeast of the intersection of Princes Street and Alfred Street. The University of Auckland buildings immediately adjacent to the site are summarised in Table 2.1. Existing services adjacent to the proposed development, within 15 m of the excavation, are summarised in Table 2.2.

Table 2.1: Basement Levels and Foundation Types

Existing structure	Location Relative to the Site	Basement Levels	Foundation Types	Details
B322 - Auckland University Students' Association Building (AUSA)	East	No basement information is available. The building is elevated approximately 1m above the adjacent ground level and is accessed by stairs. The finished floor level is approximately 43.5 mRL.	Unknown	Cracking has been observed in the AUSA masonry wall, reportedly following a previous tree-fall event.
B315 - Kate Edger Information Commons (KEIC)	East	Single basement level at approximately 38.45 mRL.	Raft Foundation	The basement is understood to be drained.
B310 - Recreation and Wellness Centre (Hiwa)	Southwest	Two basement levels, with the lower basement level at approximately 34.4 mRL.	Various foundation types	The basement is understood to be drained. Ground anchors extend from the basement walls towards and beyond the south-western boundary of the site.
B109 - UoA General Library	North	No basement information is available.	Unknown	No additional information is currently available.

Table 2.2: Nearby public services within 15 m of the excavation

Nearby Public Services (within 15 m)	Location	Description	Min. Setback distance from excavation (m)
Orakei Main Sewer (Transmission Line)	Intersect with site south-western boundary, across Princes Street	2300 mm dia. Concrete	2.0
Water Supply	Along site western boundary on Princess Street	375 mm dia. Concrete Lined Steel	6.0
Water Supply	Along site western boundary on Princes Street	150 mm dia. Cast Iron	12.0
Water Supply	Along site northern boundary on Alfred Street	100 mm dia. Cast Iron	12.0
Stormwater	Along site northern boundary on Alfred Street	225 mm dia. Concrete	11.0
Wastewater	Along site northern boundary on Alfred Street	225 mm dia. Asbestos Cement	7.5

2.5 Hiwa development observations

The proposed development is immediately north of the recent (construction 2021-2024) Hiwa Recreation Centre development. The Hiwa development included basement excavations to about 34 mRL, supported by anchored pile walls. Monitoring was undertaken during the development generally in accordance with the conditions of consent, Council ref: BUN60341464 & WAT60341466.

Groundwater monitoring at location BH201 located in Princes Street, approximately at the southwest corner of the Student Centre site indicated pre-construction variability (typically a gradual reduction) between Dec-2018 and April-2019 of around 1 to 2 m within the soil profile. During construction the groundwater was lowered at this location to about 36 mRL (about 4.3 m below the lowest recorded pre-construction level). Refer Figure 2.3.

Settlement monitoring of Building B311 and B312 (currently located on the Student Centre site and immediately behind the Hiwa pool hall wall) was undertaken during the Hiwa basement construction[4]. Recorded building settlements ranged between about 2 to 9 mm which were generally consistent with the design estimates of 5 to 10 mm.

Ground settlement monitoring on the pavement in Princes Street adjacent to the Hiwa site indicated movements were in the order of 2 to 10 mm, and less than the consented threshold of 30 mm.

Inclinometers installed in the pool hall wall recorded up to 11 mm of lateral deflection at about 5 m depth.

[4] T+T, June 2022. Bi-monthly Monitoring Report: April – May 2022 – Recreation and Wellness Centre: 17 Symonds Street, Auckland. Ref: 1001930.2000 v1.

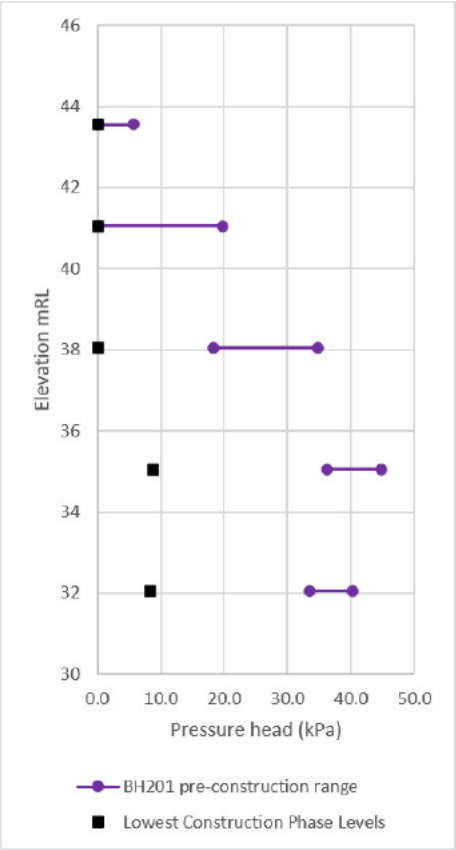

Figure 2.3: Hiwa BH201 groundwater pressure head.

3 Geology and Hydrogeology

3.1 Geotechnical model

The geotechnical model for the site is detailed in the site *GIR*[1].

The geological profile of the site, determined by review of both historic and recent geotechnical investigations typically comprises:

1 Cohesive fill; overlying

2 Weathered volcanic ash/tuff of the Auckland Volcanic Field; overlying

3 East Coast Bays Formation (ECBF). This unit grades from residual soil to sandstone/siltstone rock.

The geotechnical model results for the selected representative sections are summarised in Table 3.1.

Table 3.1: Geotechnical model of the proposed development

Geological Unit	Top Elevation of Geological Unit (mRL)		
	Section 1 (West)	Section 2 (North)	Section 3 (East)
Fill	45.5 (existing ground surface)	45.2 (existing ground surface)	42.6 (existing ground surface)
AVF	44.5	44.3	42.4
ECBF	41.5	39.2	39.0

Geological Unit	Top Elevation of Geological Unit (mRL)		
	Section 1 (West)	Section 2 (North)	Section 3 (East)
HW ECBF	37.0	35.4	34.5
ECBF Rock (N>50)	32.0	34.7	30.6

3.2 Groundwater model

3.2.1 Hydrogeological settings

The groundwater regime is governed by the topography and existing neighbouring basement developments. The Queen Street valley to the west and the Stanley Street valley to the east are key geomorphological features controlling the regional groundwater.

The site and its immediate surroundings are predominantly covered by impervious surfaces, except for Albert Park to the north. Rainfall infiltration within the site and adjacent roads will be limited due to entrainment to stormwater (an infiltration rate of 5% annually is typically adopted). Greater infiltration at Albert Park is likely to contribute to groundwater levels at the site via lateral flow.

3.2.2 Recorded groundwater levels

Groundwater beneath the proposed development is characterised by shallow, perched water within the historical fill and volcanic ash deposits.

Four standpipe piezometers were installed at the site: PZ/BH01, PZ/BH03 ("shallow" and "deep" screened standpipes) and a 7-stage multilevel PZ/BH04. These piezometers correspond to Section 1 (West), Section 2 (North) and Section 3 (East), respectively. Site-specific groundwater monitoring records taken between 8 August 2026 and 13 October 2026 and historic observations from nearby sites are presented in Appendix B and T+T *GIR*[1], respectively.

The recorded groundwater pressure profile confirms a perched groundwater regime within the soil profile at the site. The measured phreatic surface was generally 2.5 – 4.5 m bgl, from approximately 41 mRL at BH04 to 41.7 mRL at BH03 and 43 mRL at BH01.

The multi-level piezometer (PZ/BH04) monitoring recorded pore-water pressures within the soil profile of between about 15 kPa to 55 kPa. The results indicate a perched groundwater profile and pore-water pressures generally increase with depth to approximately 35 – 55kPa at 36 – 38 mRL, before reducing to approximately 40 – 45 kPa below 33 mRL.

The piezometers installed in PZ/BH01 and BH03 (deep) indicated higher pressure head of about 65 kPa which has been reducing slowly during the monitoring period.

The deeper regional groundwater level has not been definitively established. However, monitoring from the multilevel PZ/BH04 indicates that the regional groundwater level is likely to be below the maximum depth of monitoring (26.5 mRL) and will not be intercepted by the basement works.

3.2.3 Seasonal variability

Groundwater monitoring was undertaken between September and October, during the transition from late winter to spring. As rainfall is typically higher during winter and spring, the monitored groundwater levels are considered representative of seasonally high conditions.

Long-term monitoring data from the nearby Hiwa development indicates a seasonal groundwater-level variability in the order of 1 to 2 m between winter and summer.

3.2.4 Adopted groundwater profile

For the purposes of groundwater drawdown and related settlement estimates a reduction of 1m from the monitored groundwater levels has been adopted to estimate a conservative seasonal low groundwater condition. In addition, a lower bound pore-water pressure limit of 45 kPa within the level of basement excavation has been adopted for the assessment. This is generally supported by the multistage piezometer results. While higher pressures are currently being observed at the other piezometer locations they have been gradually reducing during the relatively short monitoring period to date and a lower value than currently measured is appropriate for assessment.

The assessment assumes that groundwater within the excavation footprint will be lowered to bulk excavation level, adopted as 1.0 m below the proposed basement finished floor levels (FFLs).

Locally deeper excavations may be required at column and foundation locations. However, these may be expected to be limited in extent and timeframe and are not considered for the assessment of groundwater drawdown.

For the permanent post-construction condition, a similar level is adopted to represent the proposed sub-slab drainage system.

The adopted groundwater elevations are summarised in Table 3.2 below.

Table 3.2: Adopted groundwater profile

Case	Boundary zone		
	Western	Northern	Eastern
Typical GWL for purposes of inflow assessment	43.0 mRL	41.7 mRL	41.0 mRL
Low GWL for purposes of settlement assessment	42.0 mRL	40.7 mRL	40.0 mRL
Design perched groundwater pressure limit	45 kPa		
Maximum drawdown level (bulk excavation or permanent drainage)	35.1 mRL		

3.2.5 Permeability

Rising- and falling-head permeability tests were undertaken in PZ/BH01 and PZ/BH03. The respective screened intervals were 6.5–8.0 mRL and 8.5–10.0 mRL. Further details of the testing methodology and results are provided in T+T GIR[1].

3.3 Geotechnical parameters

The geotechnical parameters adopted for the groundwater drawdown and settlement assessments were derived from site-specific laboratory and permeability testing, supplemented by T+T's experience and knowledge gained from the nearby Hiwa development. The details of the laboratory and permeability test results are provided in T+T GIR[1]and they are summarised in Table 3.3 below.

The proposed development is located near the Hiwa development, and site investigations indicate that the geological conditions at the two sites are broadly comparable.

Table 3.3: Adopted geotechnical design parameters

Geological Unit	Coefficient of horizontal hydraulic conductivity (m/sec)	ky/kx ratio	Coefficient of volume compressibility, mv (m^2/MN)
Historic Fill	1.5×10^{-7}	0.1	0.15
AVF	1.5×10^{-7}	0.1	0.15
Residual to CW ECBF	1.5×10^{-7}	0.1	0.15
HW to MW ECBF	2.0×10^{-7}	0.1	0.05
SW to UW ECBF Rock (SPT N > 50)	3.0×10^{-7}	0.1	0.005

4 Analysis results

4.1 Groundwater drawdown

The groundwater drawdown has been analysed using a pit inflow analytical model derived from Thiem-Dupuit equation[5], the resultant settlement was assessed.

The groundwater drawdown magnitude relative to the setback distance from the excavation was assessed for each of the three representative sections, as summarised in Figure 4.1.

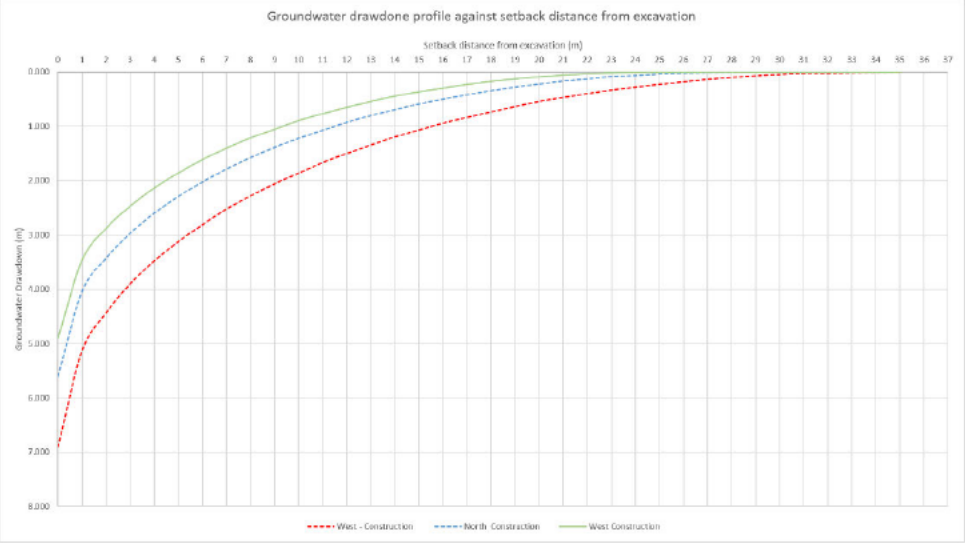

Figure 4.1: Groundwater drawdown profiles.

4.1.1 Cumulative drawdown

Within the vicinity of the Hiwa development, the proposed Student Centre is not expected to reduce groundwater levels below the levels recorded post-Hiwa construction. The risk of additional drawdown induced settlement adjacent to Hiwa is less than minor. The previously consented settlement thresholds in the vicinity of the Hiwa development are also not expected to be exceeded due to cumulative effects.

[5] F. Marinelli and W. L. Niccoli, March-April 2000. Groundwater, Vol. 38, No.2. Simple Analytical Equations for Estimating Ground Water Inflow to a Mine Pit.

The modelling which has been undertaken for the Student Centre project has taken into account the groundwater drawdown induced settlement that previously occurred due to the excavations for the Hiwa project. The estimated settlement contours (ref. Settlement Contour Plan, Appendix C) in the vicinity of Hiwa have been adjusted to take account of these drawdown effects.

4.1.2 Settlement potential due to groundwater drawdown

Groundwater drawdown reduces pore-water pressures and increases the effective stress within the soil profile. In general, where drawdown is within the historical range minor elastic deformation may occur. Drawdown outside of the historical range can result in larger consolidation settlement effects.

As the site is located along a ridgeline, with existing basements to the southeast of the site, it is likely that the groundwater levels in the upper soils have varied historically as well as seasonally to below the levels adopted for this assessment. The adopted levels are likely to be a conservative for the purposes of drawdown settlement. Comparison with the Hiwa construction monitoring indicates the theoretical results assessed for the Student Centre are conservative.

The groundwater drawdown induced consolidation settlements have been estimated using one-dimensional consolidation theory. The assessed groundwater drawdown induced settlement at various distances from the excavation were summarised in Table 4.1.

Table 4.1: Estimated groundwater drawdown induced settlement

Section	Estimated groundwater drawdown induced settlement at given distance from the excavation (mm)					
	0 m	1 m	5 m	10 m	15 m	30 m
Section 1 (West)	28	25	18	11	6	0
Section 2 (North)	26	23	15	8	4	0
Section 3 (East)	23	19	11	6	2	0

4.1.3 Groundwater inflow

Normal inflow rates have been estimated for the typical groundwater levels recorded at the site and for a hypothetical extreme rain event (saturated ground for surface at the northwest and elevated approximately 2 m above measured winter levels to the southeast). An average rate over the estimated tributary perimeter lengths have been adopted for calculation of total volumes.

Groundwater inflow estimates for normal conditions assume a long-term steady-state condition and will likely be higher during the earlier stages of construction and/or following periods of heavy rainfall. The results are summarised in Table 4.2.

Table 4.2: Groundwater inflow results

Analysis	Estimated steady state groundwater inflow (m^3/day)
Typical groundwater levels	8 – 11
Elevated groundwater levels	11 – 15

These estimates exclude inflows due to rainfall and stormwater runoff into the open excavation.

We consider that an allowance for 7.5 m^3/day to 15 m^3/day (0.09 to 0.17 L/s) groundwater inflow is appropriate for assessing options to connect to public networks for the permanent case and is anticipated to reflect seasonal and short-term peak flows.

4.2 Retaining wall induced settlements

Details of the preliminary design stage retaining wall system are included in the T+T Geotechnical Basement Retaining Design Report[6]. The assessed retaining wall deformation profiles have been used to estimate the mechanical ground settlement.

Mechanical ground settlement in the cohesive soils at the site has been assessed using the empirical method proposed by Hsieh and Ou (1998). A wall deflection-to-vertical settlement ratio of δ_{vm}/δ_{hm} = 0.5 has been adopted which is considered appropriate for the stiff cohesive soils at the site.

The assessment indicates that a spandrel-type settlement profile is likely for all three assessment sections. Accordingly, the mechanical settlement is expected to be greatest immediately adjacent to the wall and to decrease with distance from the wall.

A summary of retention induced settlement is outlined in Table 4.3 below.

The design on the wall system may change during subsequent design stages. The current assessment is expected to provide a reasonable deflection tolerance envelope. Any design changes that result in wall deformation outside of the current envelope may require revision of this assessment.

Table 4.3: Retention induced settlement

Section	Estimated retention induced settlement at given distance from the excavation (mm)					
	0 m	1 m	5 m	10 m	15 m	30 m
Section 1 (West)	11	8	6	4	3	0
Section 2 (North)	9	7	5	3	2	0
Section 3 (East)	8	7	4	2	1	0

4.3 Combined settlement

The total ground settlement adjacent to the excavation is the sum of the deformations due to wall deflections and dewatering effects.

Estimated maximum ground settlements for the critical wall design are set out in Table 4.3. As well as vertical settlements, deflection of the retaining walls is likely to cause associated lateral displacement of soil immediately behind the retaining walls. This displacement is expected to reduce with distance from the retaining wall.

Estimated total settlement profiles for Section 1, 2 and 3 are graphically presented in Figure 4.2, Figure 4.3 and Figure 4.4, respectively and are summarised in Table 4.3.

An estimated total settlement contour map has been prepared to illustrate the predicted settlement at various locations relative to the excavation and retaining walls. The contour map is provided in

[6] T+T. October 2026. UoA Waipapa Taumata Rau, Student Centre and Library – Geotechnical Groundwater and Settlement Effects Report. Ref: 1103046-RPT-GEO-105.

Appendix C.

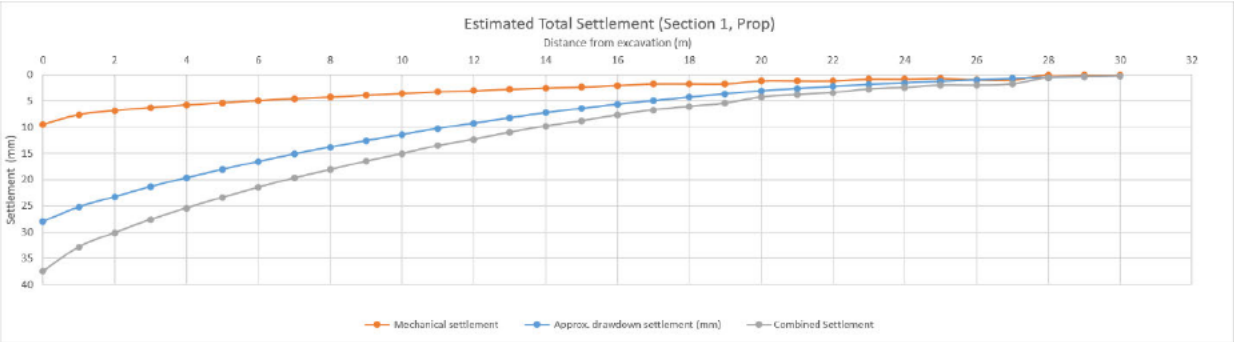

Figure 4.2: Estimated total settlement (Section 1, Prop)

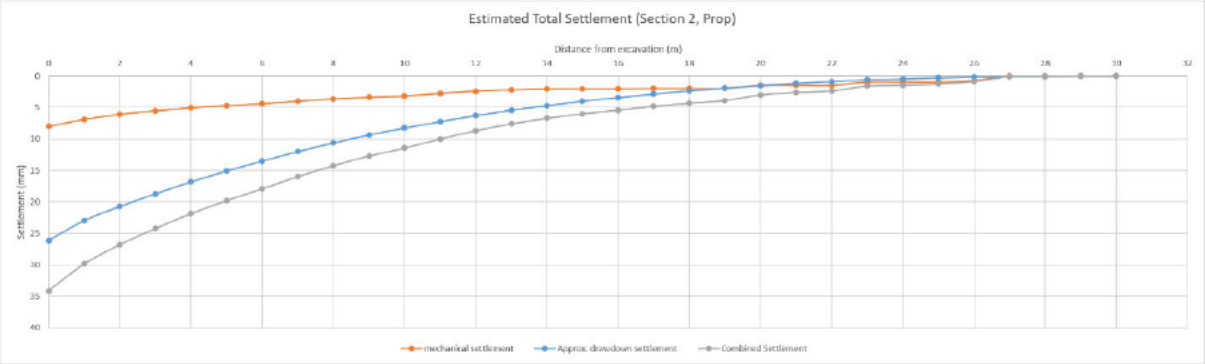

Figure 4.3: Estimated total settlement (Section 2, Prop)

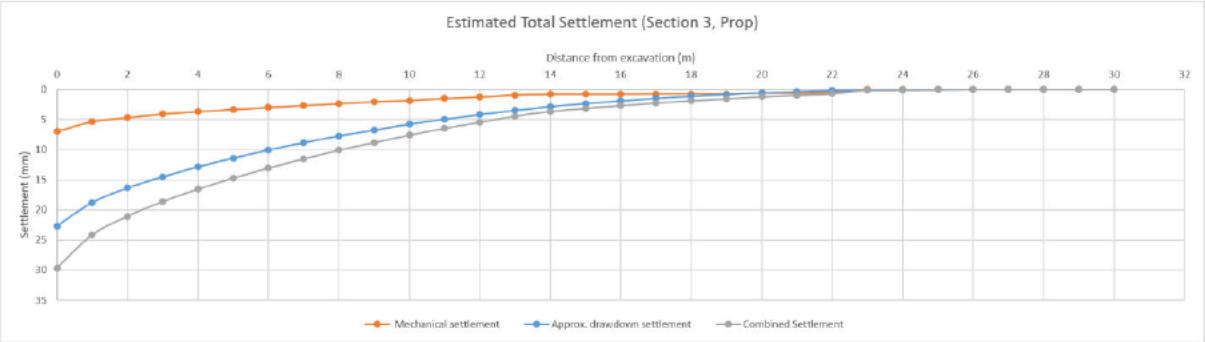

Figure 4.4: Estimated total settlement (Section 3, Prop)

Table 4.4: Estimated total ground settlements

Section	Estimated total settlement at given distance from the excavation (mm)					
	0 m	1 m	5 m	10 m	15 m	30 m
Section 1 (West)	39	33	24	15	9	0
Section 2 (North)	35	30	20	11	6	0
Section 3 (East)	31	26	15	8	3	0

5 Deformation tolerance

Ground deformation can affect adjacent buildings and infrastructure (buried services and road pavements) through changes in grade and elongation/horizontal strain. The limiting values for total and differential settlements for buildings, roads and buried services have been summarised below.

5.1 Buildings

Typical values of maximum building slope or settlement for damage risk assessment (CIRIA PR30, 1996, Table 9) are presented in Table 5.1.

Risk category 1 'negligible', has been adopted for comparison with the estimated ground deformation from the proposed development. i.e. a limiting criterion of less than 1V:500H differential settlement, and less than 10 mm total settlement. Where assessed values exceed these thresholds an assessment of limiting tensile strain (Buland 2012) may be undertaken to assess the potential damage category.

Table 5.1: Building damage assessment criteria

Risk category	Maximum Differential Settlement	Maximum Settlement of Building (mm)	Description of Risk
1	Less than 1 in 500	Less than 10	Negligible: superficial damage unlikely
2	1 in 500 to 1 in 200	10 to 50	Slight: possible superficial damage which is unlikely to have structural significance
3	1 in 200 to 1 in 50	50 to 75	Moderate: expected superficial damage and possible structural damage to building, possible damage to relatively rigid pipelines.
4	Greater than 1 in 50	Greater than 75	High: expected structural damage to buildings and rigid pipelines or possible damage to other pipelines.

5.2 Buried services

The tolerance/sensitivity of buried services to changes in grade and horizontal strain is highly dependent on construction material, type of joints and the existing condition of the service.

The damage risk criteria adopted for the effects on these utilities is generally based on O'Rourke and Trautmann (1982)[7] and is summarised in Table 5.2.

Table 5.2: Buried services damage risk assessment criteria

Type of buried pipe	Maximum allowable differential settlement
Brick unlined	1:240
Welded steel pipe	1:120
Cast in-situ concrete	1:170
PVC & HDPE	1:70

[7] O'Rourke, T D, and C H Trautmann. 1982. Buried pipeline response to tunnel ground movements. In Europipe 82 Conf., Basel, Switzerland, paper 1.

Type of buried pipe	Maximum allowable differential settlement
Reinforced concrete pipe	1:230
Ductile iron pipe	1:230
Vitrified clay pipe	1:300
Cast iron pipe (diameter category A, smaller diameter pipes up to 200 mm)	1:150
Cast iron pipe (diameter category B, larger diameter pipes greater than 200 mm)	1:500

5.3 Roads and pavements

A limiting criteria of less than 1(V):200(H) differential settlement, and less than 30 mm total settlement has been adopted for vehicle carriageway based on guidelines provided by New Zealand Transport Agency (NZTA). This criteria is applied to major roads and motorways, and therefore is considered to be conservative.

6 Assessment of Effects

6.1 Buildings

The setback distance, and the corresponding estimated total settlement for those buildings are summarised in Table 6.1.

The estimated settlement and differential settlement at the nearby UoA buildings are less than the limiting values for the negligible risk category. In accordance with Burland (2012)[8], buildings experiencing less than 10 mm of total settlement and a differential settlement ratio of less than 1 in 500 are considered to have a negligible risk of damage, and further detailed assessment is generally not required. The predicted settlements are within these limits and no consequential settlement related damage due to groundwater and retaining wall deflection induced settlement is expected.

Table 6.1: Nearby UoA buildings estimated settlement and differential settlement

Buildings	Setback distance from excavation (m)	Estimated range of settlement across the adjacent building extent	Maximum differential settlement
B322 (AUSA)	7.5	5 – 10	Less than 1 in 500
B315 (KEIC)	9.5	5 – 10	Less than 1 in 500
B310 (Hiwa)	10	0 – 5	Less than 1 in 500
B109 (General Library)	20	0 – 5	Less than 1 in 500

6.2 Buried services

Total and differential settlement estimates at the location of the services identified in the Section 2.4 are presented in Table 6.2.

[8] Burland, J.B. (2012). "Settlement and Deformation of Buildings." *ICE Manual of Geotechnical Engineering*, Volume 1, Chapter 26.

These are within the adopted tolerance limits and no consequential adverse effects are expected due to groundwater and retaining wall deflection induced settlement.

Further, the estimated ground deformations will have a negligible effect on cabled and ducted electrical and gas services due to the flexibility of cables and ducted services and their relatively high tolerance to movement.

Table 6.2: Nearby public services estimated settlement and differential settlement

Nearby Public Services (within 15 m)	Location	Description	Min. Setback distance from excavation (m)	Estimated range of settlement at service	Maximum differential settlement
Water Supply	Along site western boundary on Princess Street	375 mm dia. Concrete Lined Steel	6.0	15 – 25	Less than 1 in 500
Water Supply	Along site western boundary on Princes Street	150 mm dia. Cast Iron	12.0	10 – 15	Less than 1 in 500
Water Supply	Along site northern boundary on Alfred Street	100 mm dia. Cast Iron	12.0	5 – 10	Less than 1 in 500
Stormwater	Along site northern boundary on Alfred Street	225 mm dia. Concrete	11.0	5 – 10	Less than 1 in 500
Wastewater	Along site northern boundary on Alfred Street	225 mm dia. Asbestos Cement	7.5	5 – 10	Less than 1 in 500

6.2.1 Orakei sewer main

The Orakei Main Sewer (OMS) is a 2.3 m diameter wastewater transmission line. The Auckland Council GIS database indicates that the invert level is between 2.2 – 2.6 mRL.

Watercare requires approval for works undertaken within 10 m (horizontally or vertically) of its strategic assets.

Although the proposed basement excavation is located within the 10 m horizontal protection corridor, the proposed retaining walls and foundation piles (up to 1200 mm diameter) within 10 m horizontally of the OMS are not expected to extend below RL 27 m (i.e. not less than 24 m (at least 20 x pile diameter) above the crown of the OMS. Thus, we consider the additional stress induced by the piles to be negligible and no adverse effects on the OMS are expected.

6.3 Roads and pavements

The road boundaries for Princes Street and Alfred Street are immediately adjacent to the site boundaries and are generally 2-3 m away from the excavation according to the Earthworks Layout Plan[9]. Their estimated range of settlement and differential settlement are outlined in Table 6.3. These are within the adopted tolerance limits and no consequential adverse effects are expected due to groundwater and retaining wall deflection induced settlement.

Table 6.3: Estimated settlement and differential settlement of roads and pavements

Road boundaries	Setback distance from excavation (m)	Estimated range of settlement	Maximum differential settlement
Princes Street – Footpath	2	15 – 30	Less than 1 in 500
Princes Street – Vehicle Carriageway	11	5 – 15	Less than 1 in 500
Alfred Street – Footpath	3	10 – 25	Less than 1 in 500
Alfred Street – Vehicle Carriageway	10	5 – 10	Less than 1 in 500

7 Regulatory considerations (Auckland Unitary Plan)

We have reviewed the Auckland Unitary Plan (AUP) rules regarding the take, use, damming and diversion of groundwater that are relevant to the proposed basement excavation. The AUP provides for the take, using damming and diversion of groundwater and drilling associated with excavation. The AUP includes several requirements that must be met for developments to be considered as a permitted activities with regard to groundwater, which are listed in Activity Table E7.4.1 and Permitted Activity Standards E7.6.1.10 and E7.6.1.6.

The assessment of compliance with Permitted Activity Standard E7.6.1.10 is summarised in below and identifies a number of non-compliances and therefore further review of Permitted Activity Standard E7.6.1.6 is not required. On the basis of our assessment the project is considered to be a restricted discretionary activity in accordance with AUP, Table E7.4.1 (A20) and (A28).

Table 7.1: AUP E7 engineering assessment

E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.10. Diversion of Groundwater Caused by any Excavation (including trench), or tunnel		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
(1) All of the following activities are exempt from the Standards E7.6.1.10(2) – (6):		

[9] Beca. 21 August 2026. University of Auckland Student Centre and Library – Earthworks Layout Plan. Drawing No: 5013381-CA-2000. Rev A.

E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.10. Diversion of Groundwater Caused by any Excavation (including trench), or tunnel		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
(a) pipes cables or tunnels including associated structures which are drilled or thrust and are less than 1.2m in external diameter;	There are not expected to be any pipes cables or tunnels ≥1.2 m.	Yes
(b) pipes including associated structures up to 1.5m in external diameter where a closed face or earth pressure balanced machine is used;	N/A due to compliance with 1(a) above.	Yes
(c) piles up to 1.5m in external diameter are exempt from these standards;	All piles are expected to be <1.5 m diameter.	Yes
(d) diversions for no longer than 10 days; or	Groundwater diversion will be longer than 10 days both during construction as a result of a permanently drained basement design.	No
(e) diversions for network utilities and road network linear trenching activities that are progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days.	The groundwater diversion is for purposes other than network utilities and road network linear trenching activities	No
(2) Any excavation that extends below natural groundwater level, must not exceed:		
(a) 1ha in total area: and	(a) The development does not exceed 1ha in total area	Yes
(b) 6m depth below the natural ground level	(b) The maximum excavation depths will be greater than 6 m below existing ground levels	No
(3) The natural groundwater level must not be reduced by more than 2m on the boundary of any adjoining site.	(3) The natural groundwater level is expected to be reduced by over 2m at the University of Auckland property boundaries at Princes St and Alfred St	No
(4) Any structure, excluding sheet piling that remains in place for no more than 30 days, that physically impedes the flow of groundwater through the site must not:		
(a) impede the flow of groundwater over a length of more than 20m; and	(a) The development will impede the flow of groundwater over a length >20 m	No
(b) extend more than 2m below the natural groundwater level.	(b) The structure will extend more than 2 m below pre-development levels	No
(5) The distance to any existing building or structure (excluding timber fences and small structures on the boundary) on an adjoining site from the edge of any:		
(a) trench or open excavation that extends below natural groundwater level must be at least equal to the depth of the excavation;	(a) All adjacent structures within the extent of this clause are located on the same certificate of title. On this basis the development is considered compliant under this clause	Yes
(b) tunnel or pipe with an external diameter of 0.2 - 1.5m that extends below natural groundwater level must be 2m or greater; or	(b) All adjacent structures within the extent of this clause are located on the same certificate of title. On this basis the	Yes

E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.10. Diversion of Groundwater Caused by any Excavation (including trench), or tunnel		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
	development is considered compliant under this clause	
(c) a tunnel or pipe with an external diameter of up to 0.2m that extends below natural groundwater level has no separation requirement.	(c) No comment required	Yes
(6) The distance from the edge of any excavation that extends below natural groundwater level, must not be less than:		
(a) 50m from the Wetland Management Areas Overlay;	(a) The site is greater than 50 m from a Westland Management Area	Yes
(b) 10m from a scheduled Historic Heritage Overlay; or	(b) An historic heritage area exists within 10m of the edge of the proposed excavation in the area of the existing University Buildings B311 and B312.	No
(c) 10m from a lawful groundwater take	(c) A search of groundwater takes adjacent to the site has not been undertaken. However, it is considered unlikely that groundwater take, other than for existing drained basement structures which are located on the same certificate of title, occurs within 10m of the proposed development.	Yes

8 Monitoring and contingency

8.1 Proposed instrumentation and monitoring

We recommend that construction monitoring of the retaining wall deflections and related potential ground and building movements is undertaken to check compliance with the design criteria. The monitoring methodology and frequency should be undertaken in accordance with a project specific Monitoring and Contingency Plan.

A draft monitoring location plan has been developed to support the substantive application, and this is provided in **Appendix D**, and details of the proposed monitoring plan are summarised in the following subsections. The final monitoring and contingency plan to be submitted for certification may be amended to reflect changes made in the design prior to construction.

8.1.1 Services condition surveys

Prior to the commencement of dewatering and following completion of dewatering (and within 6 months of completion of construction), a condition survey of potentially affected buried services (refer Table 2.1) shall be undertaken in consultation with the relevant service provider.

Suitable condition surveys are expected to comprise CCTV survey for stormwater and wastewater services and shall include the following but not limited to:

1 Existing levels of aesthetic damage.

2 Existing levels of serviceability damage.

3 Existing levels of structural damage.

4 Photographic/video evidence of (1), (2), and (3) above.

Suitable condition surveys are expected to comprise acoustic leak detection for water supply services.

A condition survey is not required where written evidence is provided to the Council that the owner of that service has confirmed they do not require a condition survey.

8.1.2 Retaining wall deflection monitoring

The retaining wall monitoring points are shown in Appendix D and include capping beam monitoring pins at approximately 15m centres and inclinometers at selected locations. The wall inclinometers should be installed within the retaining piles which are socketed into ECBF rock.

For establishing a baseline:

- Two baseline surveys shall be undertaken for the monitoring points, and survey (including subsequent ones) shall be accurate up to $\pm$ 2 mm
- One baseline survey shall be undertaken for the inclinometer

The monitoring frequency during the different phases of construction shall be:

Construction stage	Frequency
After commencement of dewatering and until one month after completing of bulk excavation	Fortnightly and at every 2 metres depth excavation or when changes to the propping system are being carried out.
One month following basement excavation and until three months after the completion of dewatering	Monthly

Results of this monitoring are to be compared with the design assumptions and baseline readings. Trigger levels at which actions are required to be undertaken are summarised in Table 8.1. If the Trigger Levels in Table 8.1. are reached, the actions outlined in Section 8.2 shall be carried out.

Table 8.1: Retaining wall displacement trigger levels

Type of monitoring	Feature monitored	Monitoring point ID	Alert trigger[1], mm	Alarm trigger[1], mm
Inclinometers	Western basement wall	IN1	15	20
	Northern basement wall	IN2	10	15
	Eastern basement wall	IN3	10	15
Wall displacement pins	Southwestern basement wall	RW1 – RW2	7	10
	Western basement wall	RW3 – RW6	7	10
	Northern basement wall	RW7 – RW11	7	10
	Eastern basement wall	RW12 – RW16	7	10

Note: [1] Lateral displacement towards excavation.

8.1.3 Ground condition survey

Visual survey/inspection of surrounding ground, pavement and street furniture within 10 m of active works shall be undertaken to monitor any deterioration or cracking, and this shall be undertaken the direction of a suitably qualified engineering professional (SQEP).

Prior to commencement of works, a pre-condition survey shall be undertaken to establish the existing condition of the asset including existing level of damage, and to assess the susceptibility to further movement and damage. The frequency of visual inspection shall be weekly during bulk excavation and reducing to fortnightly following completion of bulk excavation of the basement until completion of dewatering. The assessment shall be typically undertaken by the Contractor. The trigger levels for the visual survey/inspection shall be taken as:

- Alert: Any visual indication of deterioration or cracking by Contractor.
- Alarm: Assessment by Engineer indicates damage likely to worsen.

8.1.4 Ground and building deformation monitoring

The ground and building monitoring points are shown in Appendix D which are intended to monitor and confirm that ground settlements are within the design criteria. For the building monitoring points, marks shall be set as low as practicable on the building on elements in direct connection with the foundation level (i.e. columns or perimeter footings).

At least two baseline surveys shall be undertaken for the monitoring points, and survey shall be accurate up to ± 2 mm.

The monitoring frequency during the different phases of construction shall be:

Construction stage	Frequency
From commencement of dewatering and until completion of dewatering	Weekly.
After completion of dewatering	Monthly for three months or until such a time following the completion of dewatering that stable measurements are demonstrated, and written approval is granted from the Council.

Results of this monitoring are to be compared with the design assumptions and baseline readings. Trigger levels at which actions are required to be undertaken are summarised in Table 8.2. If the Trigger Levels in Table 8.2. are reached, the actions outlined in Section 8.2 shall be carried out.

Table 8.2: Ground and building deformation trigger levels

Type of monitoring	Feature monitored	Settlement marker ID	Total settlement, mm		Differential settlement [1]	
			Alert trigger	Alarm trigger	Alert trigger	Alarm trigger
Building monitoring point	B322	BS1 – BS5	5	10	1:700	1:500
	B315	BS6 – BS7				
	B310	BS8 – BS9				
	Princes Street Footpath	GS1 – GS4	20	30	1:300	1:200

Type of monitoring	Feature monitored	Settlement marker ID	Total settlement, mm		Differential settlement [1]	
			Alert trigger	Alarm trigger	Alert trigger	Alarm trigger
Ground monitoring point	Princes Street Vehicle Carriageway	GS5 – GS8				
	Alfred Street Footpath	GS9 – GS13				
	Alfred Street Vehicle Carriageway	GS14 – GS18				

Note: [1] Differential settlement is measured between two adjacent building/ground monitoring pins.

8.2 Contingency measures

8.2.1 Retaining wall deflection contingency measures

In the event of retaining wall deflections exceeding the monitoring trigger levels, a review of the retentiondesign model shall be carried out to assess the load in the wall and existing props. If required, the following actions may be taken:

1 Assess condition of prop and/or anchor connections/headworks and/or prestress
2 Install additional props and/or anchors
3 Place a berm of soil in front of the wall

8.2.2 Ground and building deformation contingency measures

In the event of ground or building deformation exceeding the monitoring trigger levels, one or more of the following actions shall be taken:

Discussions on the situation with the property/service owner that may be affected,

1 Monitor the rate of settlement (assuming that other steps have been undertaken to address the cause)
2 Check public safety is maintained
3 Isolation or underpinning of affected structures/services; and
4 Acceptance and reinstatement of any resultant damage.

9 Applicability

This report has been prepared for the exclusive use of our client The University of Auckland, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application Fast-track Approvals Act 2024 and that the Expert Panel as the consenting authority will use this report for the purpose of assessing that application.

Recommendations and opinions in this report are based on data from discrete investigation locations. The nature and continuity of subsoil away from these locations are inferred but it must be appreciated that actual conditions could vary from the assumed model.

During excavation and construction, the site should be examined by a geological engineer or engineering geologist competent to judge whether the exposed subsoils are compatible with the inferred conditions on which the report has been based.

Compliance with the Environment Court Practice Note 2023

I, Matthew Kent, confirm that in my capacity as technical reviewer of this report, I have read and abided by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses contained in the Practice Note 2023.

I am a Principal Geotechnical Engineer at Tonkin & Taylor Ltd (T+T), where I specialise in geotechnical engineering investigation, design and construction verification for commercial and infrastructure developments. I have 20 years of industry experience and have worked at T+T since 2013. I am a chartered member of Engineering New Zealand and a chartered professional engineer (CPEng).

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:

.....

Tommy Lam
Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:

.....

Chris Freer
Project Director

Technical review by Matthew Kent, Senior Geotechnical Engineer

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Appendix A Concept civil and structural plans

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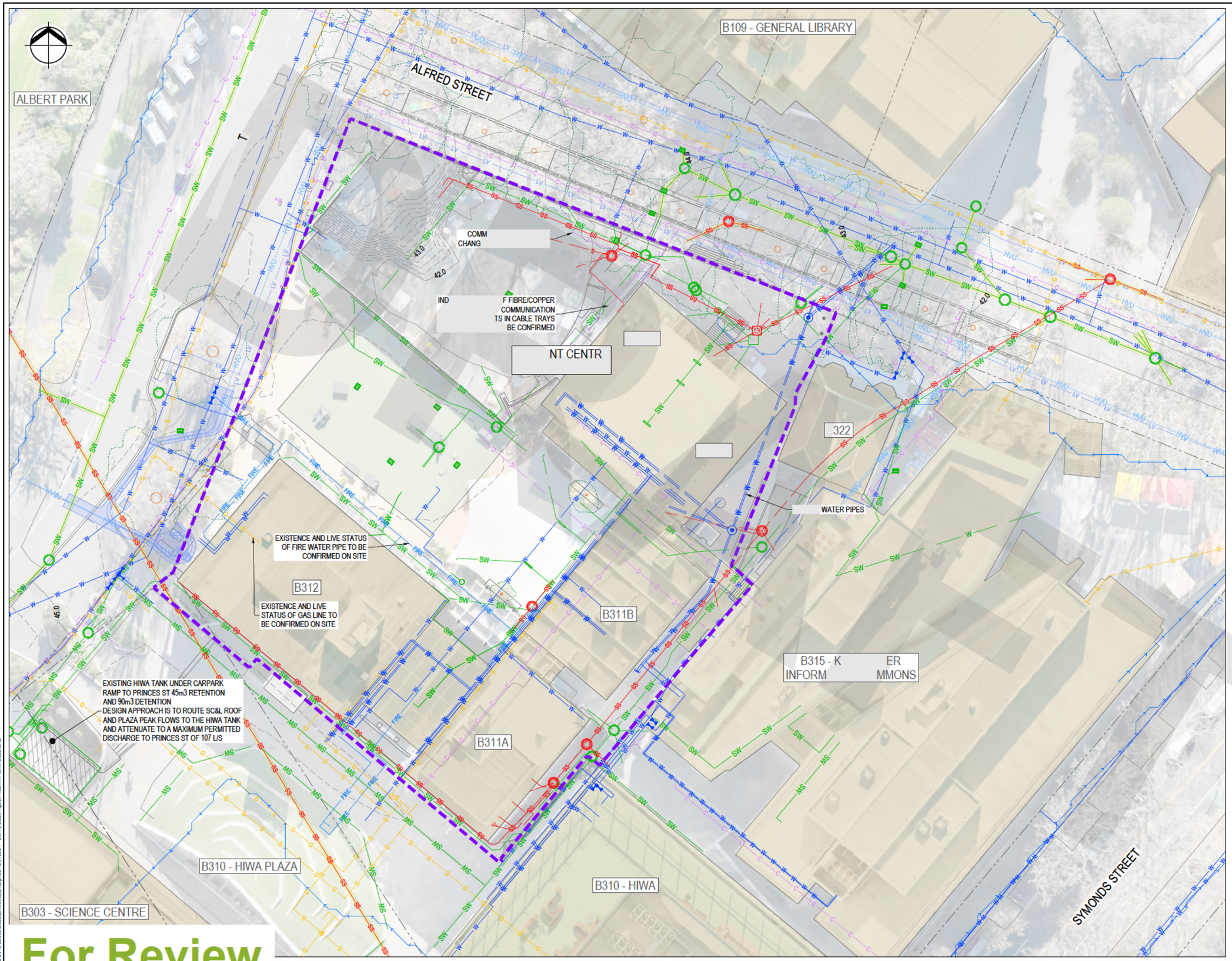

LEGEND:

- EXTENT OF WORKS
- CADASTRAL BOUNDARY
- 41.0 EXISTING CONTOUR MAJOR (1.0m)
- 40.75 EXISTING CONTOUR MINOR (0.25m)
- EXISTING BUILDINGS
- PUBLIC SERVICE
- SW EXISTING STORMWATER
- EXISTING STORMWATER CHANNEL
- SS EXISTING WASTEWATER
- C EXISTING COMMS
- LV EXISTING LOW VOLTAGE
- HVU EXISTING HIGH VOLTAGE
- L EXISTING LIGHTING
- G EXISTING GAS MAIN
- W EXISTING WATER MAIN
- FIRE EXISTING FIRE WATER
- CSS EXISTING COMBINED STORMWATER/WASTEWATER
- EXISTING VECTOR EASEMENT
- EXISTING TREE TRUNK & DRIPLINE
- EXISTING OVERLAND FLOW PATH

NOTES:

1. REFER TO DRAWING 501338-CA-0001 FOR GENERAL NOTES.
2. REFER TO BUILDING SERVICES DRAWINGS FOR INTERNAL BUILDING PIPEWORK.
3. REFER TO TOPOGRAPHICAL SURVEY 7119-600-01, REVISION 0 FROM B. N. WALKER SURVEYING 2016 LTD FOR EXISTING SERVICES INFORMAT ON.

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Original Scale (A1) 1:250	Design	S.ZHU	21.08.26
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	Drg Check	S.SEWELL	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

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Client: Waipapa Taumata Rau University of Auckland

Project: UNIVERSITY OF AUCKLAND STUDENT CENTRE AND LIBRARY

Title: EXISTING SITE SERVICES LAYOUT

Discipline: CIVIL ENGINEERING

Drawing No.: 5013381-CA-1100

Rev.: A

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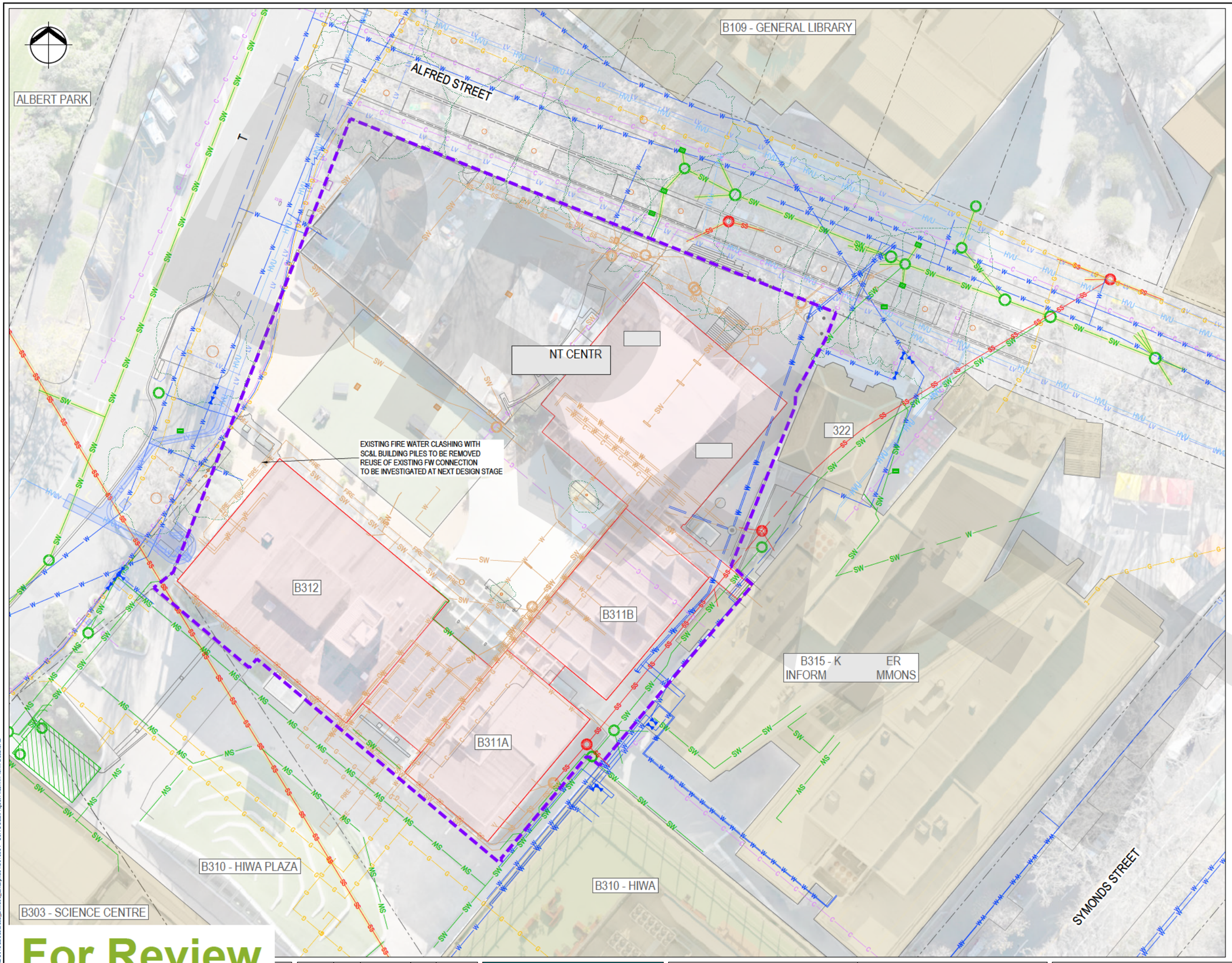

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- 40.75 EXISTING CONTOUR MINOR (0.25m)
- EXISTING BUILDINGS
- EXISTING BUILDING TO BE DEMOLISHED
- SW EXISTING STORMWATER
- EXISTING STORMWATER CHANNEL
- SS EXISTING WASTEWATER
- PUBLIC SERVICE
- C EXISTING COMMS
- LV EXISTING LOW VOLTAGE
- HVU EXISTING HIGH VOLTAGE
- G EXISTING GAS MAIN
- W EXISTING WATER MAIN
- FIRE EXISTING FIRE WATER
- CSS EXISTING COMBINED STORMWATER/WASTEWATER
- SW EXISTING STORMWATER TO BE ABANDONED
- SS EXISTING WASTEWATER TO BE ABANDONED
- C EXISTING COMMS TO BE ABANDONED
- G EXISTING GAS MAIN TO BE ABANDONED
- W EXISTING WATER MAIN TO BE ABANDONED
- FIRE EXISTING FIRE WATER TO BE ABANDONED
- EXISTING VECTOR EASEMENT
- EXISTING TREE TRUNK & DRIPLINE

NOTES:

1. REFER TO DRAWING 501338-CA-0001 FOR GENERAL NOTES.
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Reduced Scale (A3) 1:500	Drawn	A.FRANCOMBE	21.08.26	
	Dsg Verifier	C.BREYTENBACH		
	Drg Check	S.SEWELL		Date
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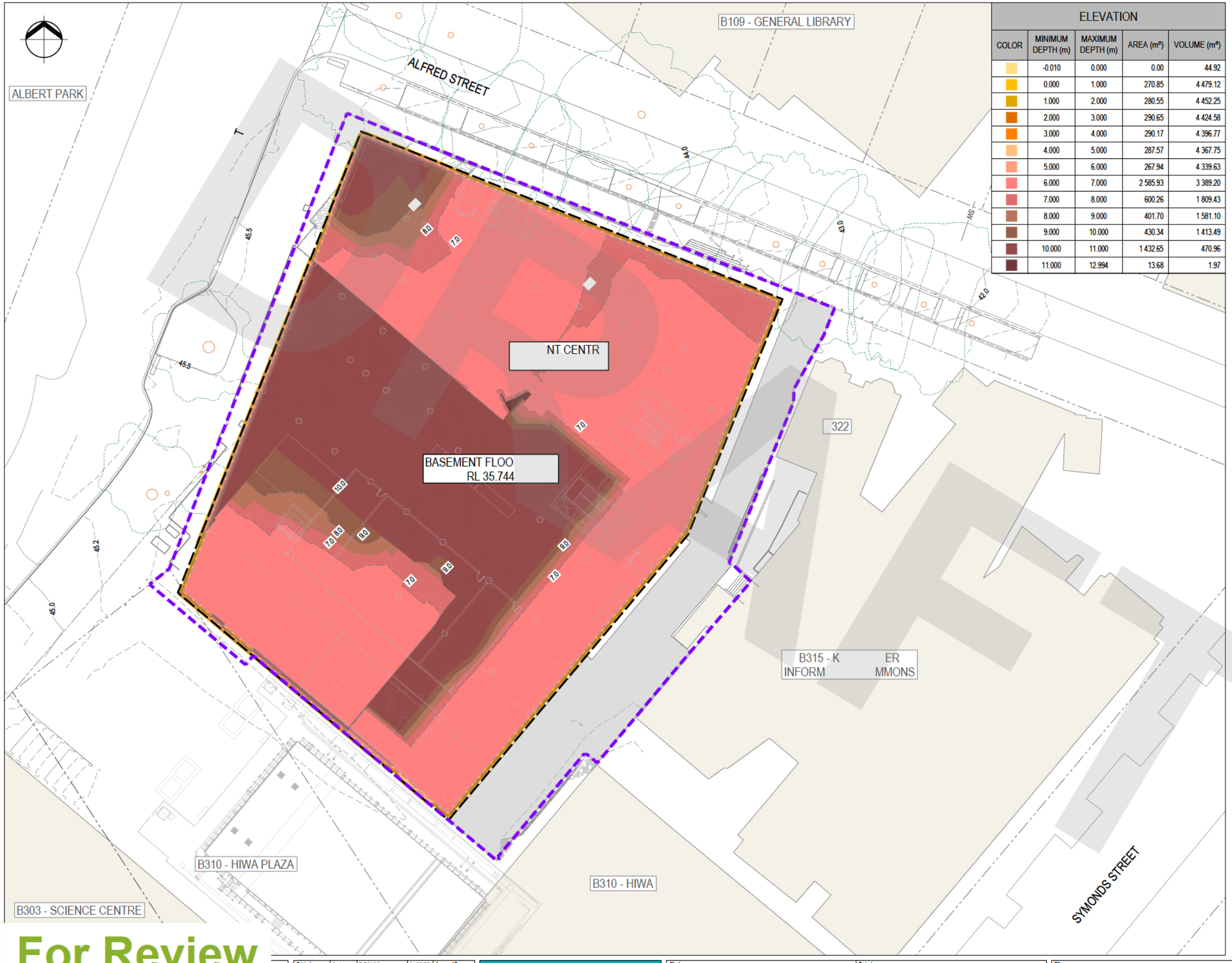

ELEVATION

COLOR	MINIMUM DEPTH (m)	MAXIMUM DEPTH (m)	AREA (m²)	VOLUME (m³)
	-0.010	0.000	0.00	44.92
	0.000	1.000	270.85	4 479.12
	1.000	2.000	280.55	4 452.25
	2.000	3.000	290.65	4 424.58
	3.000	4.000	290.17	4 396.77
	4.000	5.000	287.57	4 367.75
	5.000	6.000	267.94	4 339.63
	6.000	7.000	2 585.93	3 389.20
	7.000	8.000	600.26	1 809.43
	8.000	9.000	401.70	1 581.10
	9.000	10.000	430.34	1 413.49
	10.000	11.000	1 432.65	470.96
	11.000	12.994	13.68	1.97

LEGEND:

- EXTENT OF WORKS
- CADASTRAL BOUNDARY
- NEW BUILDING OUTLINE
- NEW BUILDING
- EXISTING BUILDINGS
- 41.0 EXISTING CONTOUR MAJOR (1.0m)
- 40.75 EXISTING CONTOUR MINOR (0.25m)
- NEW PAVED AREA
- EXISTING TREE TRUNK & DRIPLINE

NOTES:

1. REFER TO DRAWINGS 5013381-CA-1100 FOR DETAILS OF EXISTING SERVICES.
2. REFER TO TABLE 1 FOR SUMMARY OF EARTHWORKS VOLUMES. EARTHWORKS VOLUMES ARE ESTIMATES ONLY.
3. CUT AND FILL VOLUMES ISOPACH IS A COMPARISON OF THE TEMPORARY POST DEMOLITION GROUND SURFACE (REPRESENTING THE SITE FOLLOWING THE REMOVAL OF BUILDINGS B311 AND B312 AND ASSOCIATED FOUNDATIONS) AGAINST THE PROPOSED BUILDING EXCAVATION SURFACE.
4. EXISTING EXTERNAL LEVELS USED FOR THIS DRAWING ARE BASED ON THE TOPOGRAPHICAL SURVEY COMPLETED BY B.N.WALKER SURVEYING 2016 LTD DATED 30 JULY 2026. EXISTING GROUND LEVELS AT BUILDINGS HAVE BEEN INTERPOLATED BASED ON SURVEYED LEVELS SURROUNDING THE BUILDINGS.
5. THIS PLAN SHOWS EXCAVATION WORKS REQUIRED FOR THE CONSTRUCTION OF THE FOUNDATION LEVEL OF THE PROPOSED BUILDING ONLY. LOCALISED EXCAVATION FOR FOUNDATION FOOTINGS, SLAB THICKENINGS, SUBSOIL DRAINS, TRENCHES AND SIMILAR WORKS IS NOT SHOWN ON THIS PLAN. THE EXCAVATION EXTENT SHOWN REPRESENTS THE THEORETICAL MAXIMUM AND IS PROVIDED FOR INFORMATION ONLY. THE CONTRACTOR SHALL REVIEW AND ADJUST THE EXCAVATION EXTENT ON SITE AS REQUIRED.
6. IT IS ASSUMED THAT EXCAVATIONS AT VERTICAL FACES WILL ONLY OCCUR WHEN THE REQUIRED RETAINING STRUCTURE IS IN PLACE. THE CONTRACTOR SHALL ENSURE ALL CUT SLOPES REMAIN STABLE AT ALL TIMES AND SHALL SEEK AND FOLLOW ADVICE FROM THE PROJECT GEOTECHNICAL ENGINEER.
7. DESIGN FINISHED FLOOR LEVELS USED FOR THIS DRAWING ARE SHOWN ON DRAWINGS 5013381-CA-3000. THESE LEVELS WILL BE FURTHER DEVELOPED WITH THE CONTRACTOR TO FINALISE APPROXIMATE EARTHWORKS VOLUMES.

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28/08/2026 11:55:09 am

Original Scale (A1) 1:250	Design	R.SALAS	21.08.26	Approved For Construction*
	Drawn	A.FRANCOMBE	21.08.26	
Reduced Scale (A3) 1:500	Dsg Verifier	C.BREYTENBACH		
	Drg Check	S.SEWELL		Date
	* Refer to Revision 1 for Original Signature			

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Client: Waipapa Taumata Rau University of Auckland

Project: UNIVERSITY OF AUCKLAND STUDENT CENTRE AND LIBRARY

Title: EARTHWORKS LAYOUT

Discipline: CIVIL ENGINEERING

Drawing No.: 5013381-CA-2000

Rev.: A

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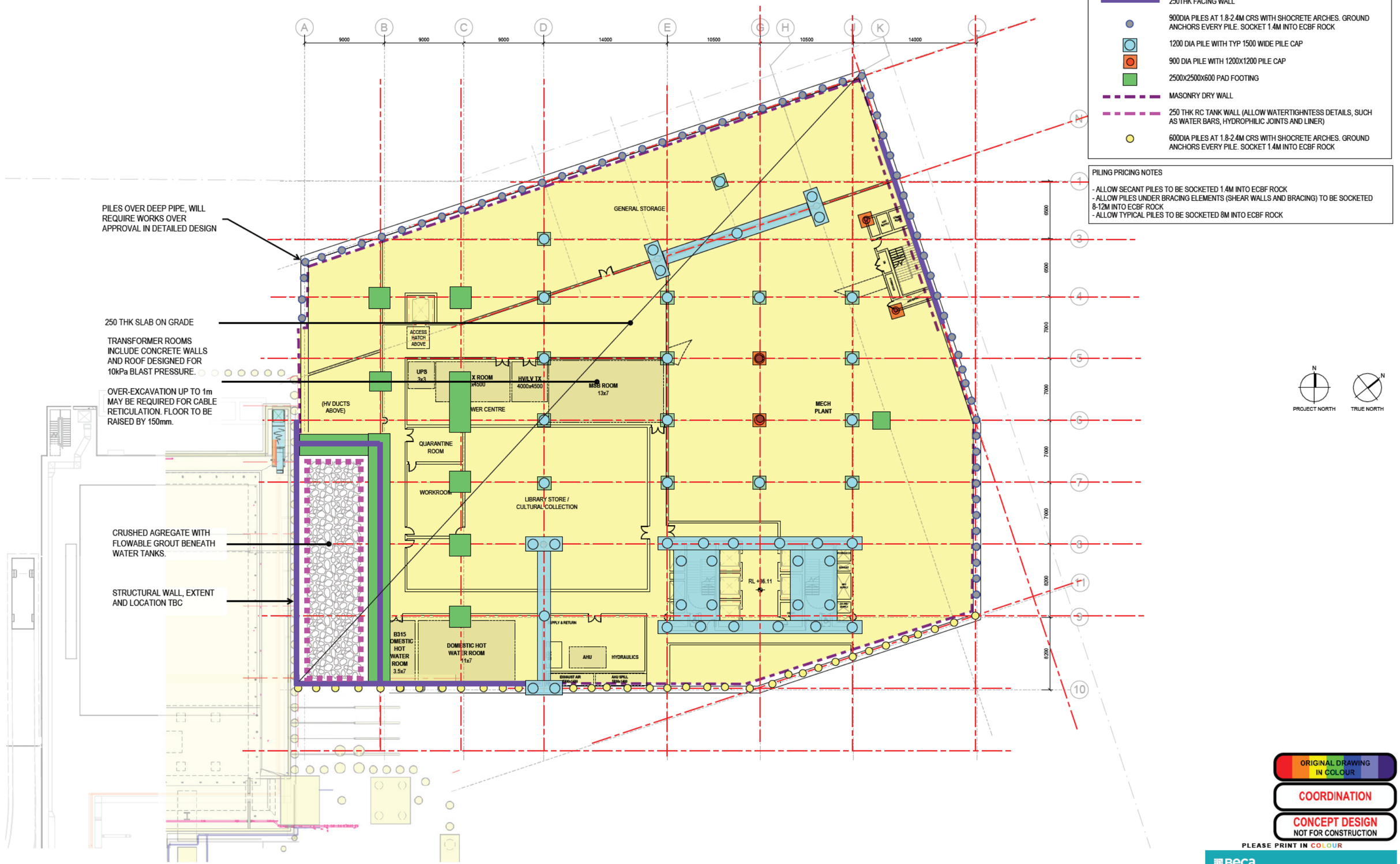

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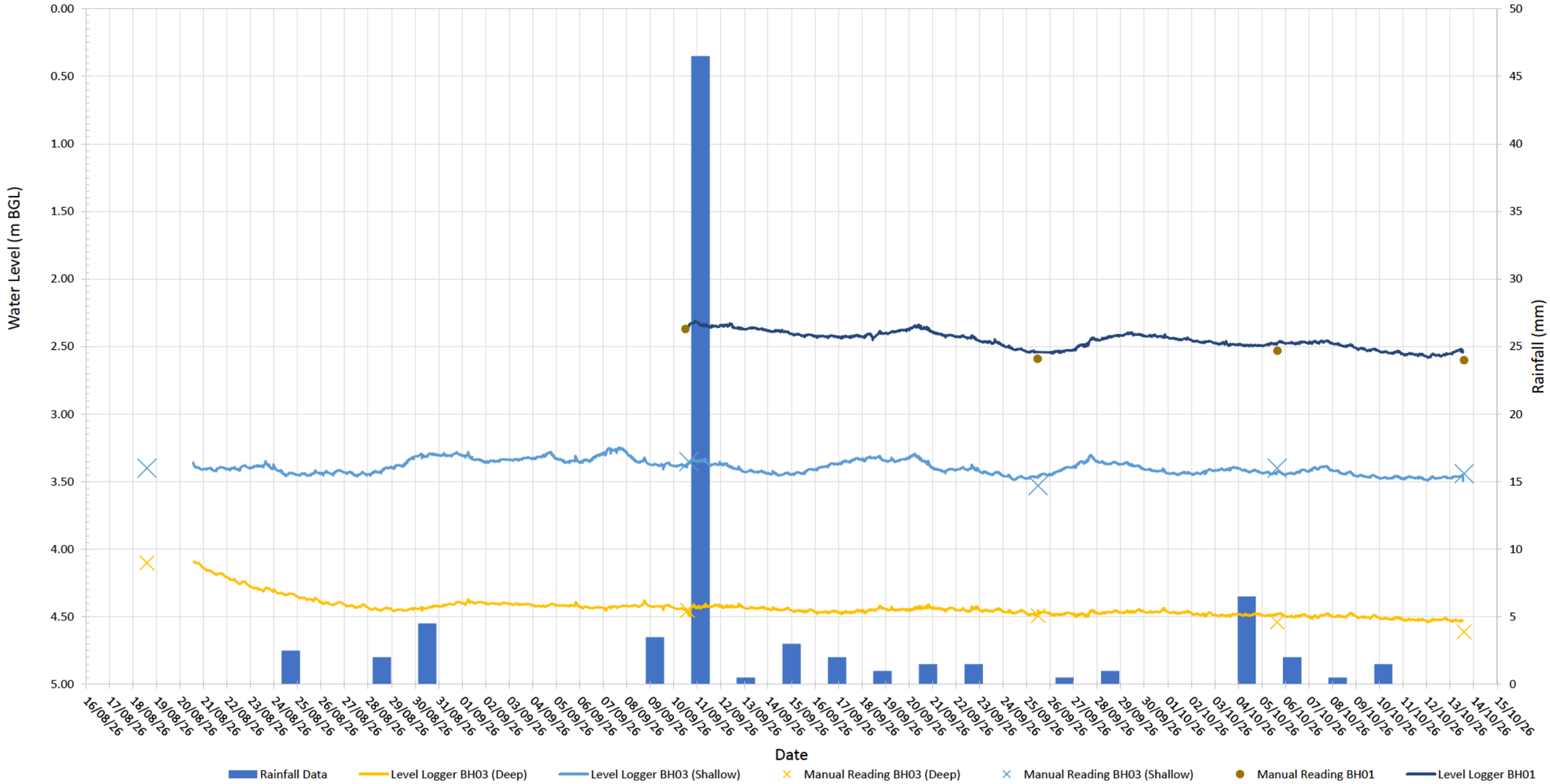
JOB TITLE:	STUDENT CENTRE AND LIBRARY
SKETCH TITLE:	LEVEL B1 FOUNDATION PLAN

DATE:	04/09/2026	JOB No.:	5013381
SCALE:	NTS	SKETCH No.:	5013381-SE-K201
DRAWN:	SNC	REV:	B
VERIFIED:	SBT	APPROVED:	PLB
REASON FOR ISSUE:	CONCEPT		
SOURCE OF BACKGROUND:	WAM ARCHITECTURAL BACKGROUNDS		

Appendix B Groundwater assessment

- **Site-specific groundwater monitoring results**
- **Groundwater drawdown profile summary**

University of Auckland Student Centre & Library BH03 Dual-Nested Piezometer
Groundwater Monitoring Results



Multilevel Piezometer Monitoring Record Sheet - UoA Alfred Street

BH ID:		BH04 (PZ)													
Piezometer ID:		BH C1 (3m)		BH C2 (6m)		BH C3 (9m)		BH C4 (12m)		BH C5 (15m)		BH C6 (18m)		Center (21m)	
Stick-Up (m):		-0.07		-0.07		-0.07		-0.07		-0.07		-0.07		-0.07	
Measured Depth (mBGL):		3.04		6.03		9.05		12.06		15.06		18.04		21.00	
Drilling Datum RL(m):		42.63		42.63		42.63		42.63		42.63		42.63		42.63	
Target Screen Depth (m):		3.00		6.00		9.00		12.00		15.00		18.00		21.00	
		MEASURED WATER LEVEL (BGL)													
DATE	READ BY	Water Depth (mBGL)	**Water Level RL (m)**	Water Depth (mBGL)	**Water Level RL (m)**	Water Depth (mBGL)	**Water Level RL (m)**	Water Depth (mBGL)	**Water Level RL (m)**	Water Depth (mBGL)	**Water Level RL (m)**	Water Depth (mBGL)	**Water Level RL (m)**	Water Depth (mBGL)	**Water Level RL (m)**
9/28/2026	BUWI	1.63	**41.00**	0.71	**41.92**	5.11	**37.52**	7.22	**35.41**	12.60	**30.03**	13.74	**28.89**	16.16	**26.47**
10/7/2026	BUWI	1.72	**40.91**	0.84	**41.79**	5.14	**37.49**	7.20	**35.43**	12.93	**29.70**	14.11	**28.52**	16.39	**26.24**
10/12/2026	BUWI	1.88	**40.75**	0.86	**41.77**	5.15	**37.48**	7.19	**35.44**	12.96	**29.67**	14.03	**28.60**	16.19	**26.44**
10/22/2026	SADU	1.78	**40.85**	0.80	**41.83**	5.08	**37.55**	7.10	**35.53**	12.93	**29.70**	14.02	**28.61**	16.20	**26.43**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**
			42.63		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**		**42.63**

COMMENTS

Appendix C Estimated total settlement contour map

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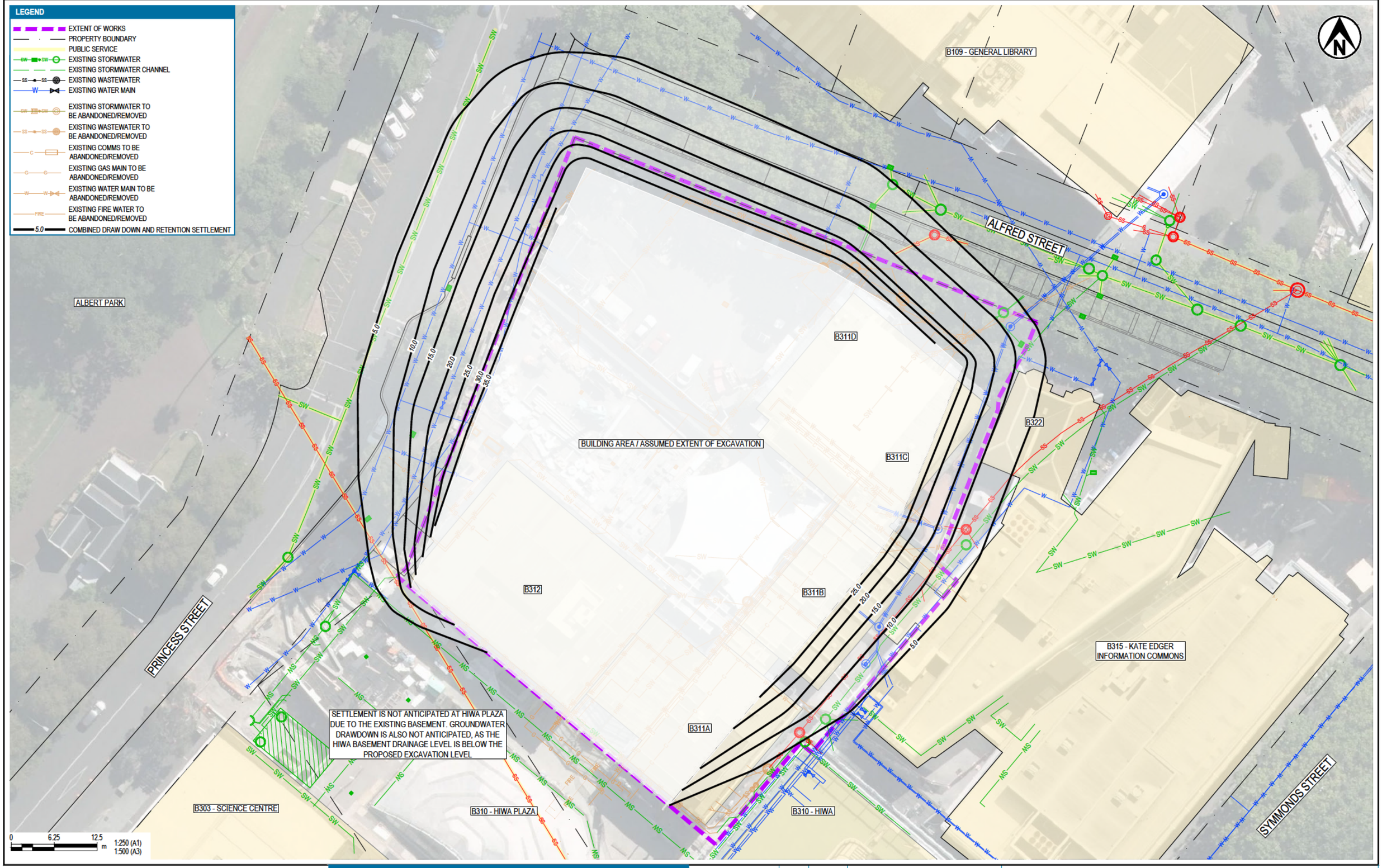
\\ttgroup.local\corporate\Auckland\Projects\1103046\WorkingMaterial\Cad\DWG\FIG\1103046.1000-F2.dwg 2026-Oct-22 1:41:26 pm Plotted By: HOTI



NOTES

1. COORDINATE SYSTEM: NZGD2000/ NEW ZEALAND TRAVERSE MERCATOR 2000.
2. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016.
3. PROPERTY BOUNDARIES SOURCED FROM LAND INFORMATION NEW ZEALAND (LINZ) LICENSED FOR REUSE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE, https://data.linz.govt.nz/layer/50767-nz-topo50-maps/, ACCESSED 11SEPTEMBER 2026.
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DRAWN	HOTI	OCT.26	PROJECT PHASE: RESOURCE CONSENT
DESIGN CHECKED			
FIGURE CHECKED			

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APPROVED DATE

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TITLE PLAN
SETTLEMENT CONTOUR PLAN

DRAFT

SCALE (A1) 1:250 FIG No. 1103046.FIG-GEO-01 REV 1

Appendix D Draft monitoring location plan

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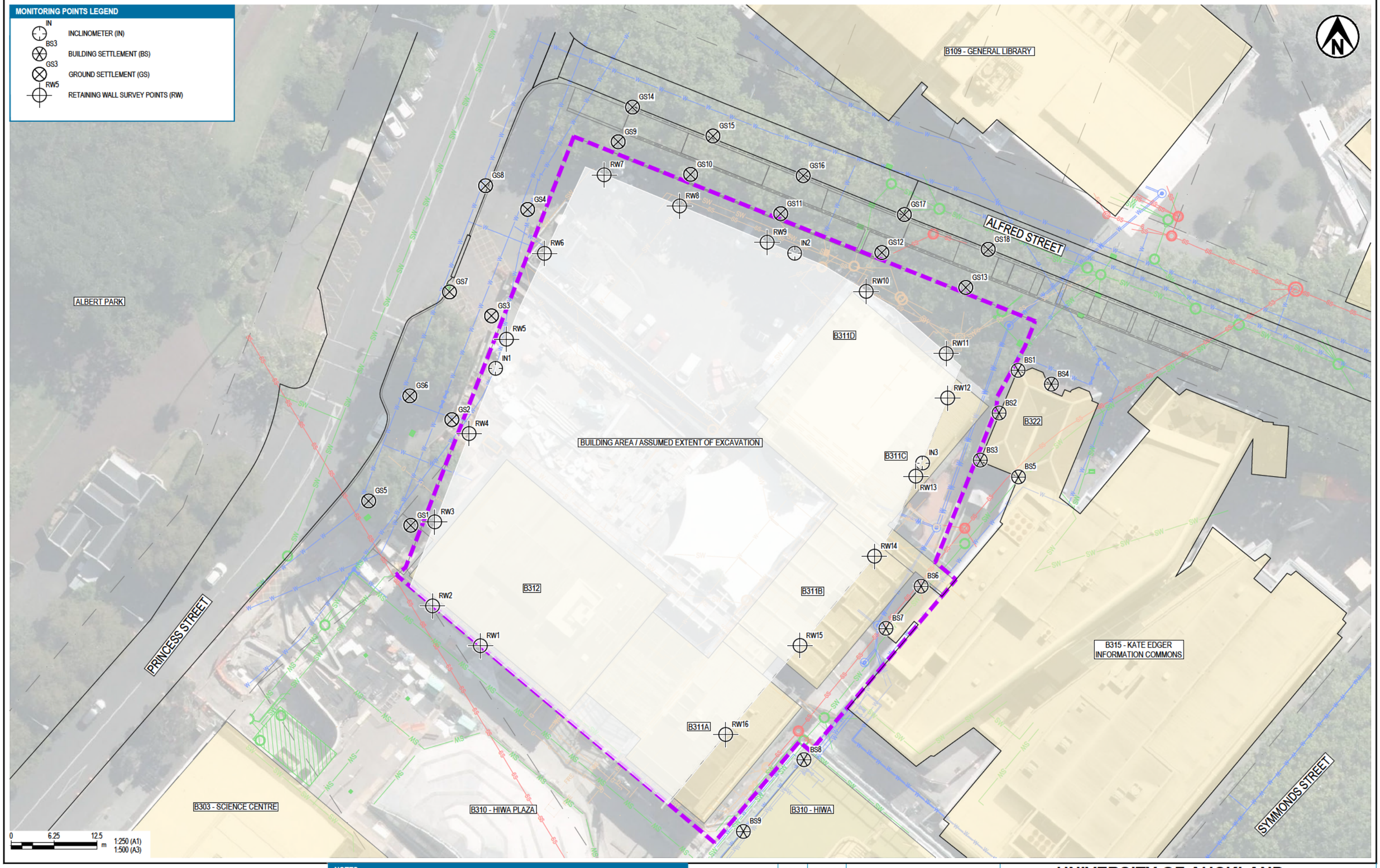
\\ttgroup.local\corporate\Auckland\Projects\1103046\WorkingMaterial\Cad\DWG\FIG\1103046.1000-F3.dwg 2026-Oct-22 1:41:38 pm Plotted By: HOTI

MONITORING POINTS LEGEND

- IN — INCLINOMETER (IN)
- BS3 — BUILDING SETTLEMENT (BS)
- GS3 — GROUND SETTLEMENT (GS)
- RW5 — RETAINING WALL SURVEY POINTS (RW)



NOTES

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DESIGN CHECKED			
FIGURE CHECKED			
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TITLE PLAN
SETTLEMENT MONITORING PLAN

DRAFT

SCALE (A1) 1:250 FIG No. 1103046.FIG-GEO-01 REV 1



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